Citation:

Surwit RS, Feinglos MN, McCaskill CC, Clay SL, Babyak MA, Brownlow BS, Plaisted CS, Lin PH. Metabolic and behavioral effects of a high-sucrose diet during weight loss. *Am J Clin Nutr.* 1997 Apr;65(4):908-15.

PubMed ID: 9094871

Study Design:

Randomized Clinical Trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To study the comparative effects of high and low sucrose, low-fat, hypoenergetic diets on a variety of metabolic and behavioral indexes in a 6-wk controlled weight-loss program in order to determine both the safety and efficacy of high-sucrose diets during weight reduction.

Inclusion Criteria:

- Female
- 130 - 200% of ideal body weight

Exclusion Criteria:

- Use of drugs affecting the autonomic nervous system or metabolism (including tobacco)
- Use of psychotropic agent
- History of significant cardiopulmonary, neurological, gastrointestinal or endocrinologic illness
- Participation in regular exercise program

Description of Study Protocol:

Recruitment: Recruited through advertising (advertisement type not specified)

Design: Randomized clinical trial

Subjects were paired to control for body mass index (BMI), age and menstrual status and then randomly assigned within pairs to either a high or low sucrose diet. The controlled feeding study provided subjects with all meals and snacks for the six week period, breakfast and lunch packed as take out meals and dinner served in a communal dining room. Subjects also received a list of beverages and seasonings that could be consumed freely.

Blinding used (if applicable): implied with laboratory measurements

Intervention (if applicable):

- Both diets contained ≈4606 kJ energy/d with 11% of energy as fat, 19% as protein, and 71% as carbohydrate.
  - The high-sucrose diet contained 43% of the total daily energy intake as sucrose.
  - The low-sucrose diet contained 4% of the total daily energy intake as sucrose.

Statistical Analysis

- Analysis of variance (ANOVA) conducted for analyses of treatment effects.

Data Collection Summary:

Timing of Measurements

- Pre-diet evaluation included measurement of body composition (using dual-energy X-ray absorptiometry), resting energy expenditure (using indirect calorimetry with a ventilated-hood system), thyroid hormones (TSH), free triiodothyronine (FT_3) and free thyroxine (FT_4), fasting plasma lipid concentrations, fasting serum glucose and 24 hour urinary norepinephrine and nitrogen
- Pre-diet evaluation was repeated during the final week of the diet
- Measurement of thyroid hormone, serum glucose and urinary norepinephrine concentrations and questionnaires were repeated at the intervention midpoint
- Spielberger State-Trait Anxiety Inventory, Beck Depression Inventory and the Positive and Negative Affect Scale (PANAS) conducted at baseline and midpoints, with exception of the PANAS which was conducted weekly, to determine subjects' anxiety and depression
- The Modified Continuous Performance Task was used to assess subjects' attention and impulsivity
- Blood pressure measured twice weekly
- Weight recorded five times weekly
- Daily diary used to document deviations from study diet, hunger, health problems or concerns

Dependent Variables

Changes to and differences between groups for:

- Weight change
- Percentage total body fat
- Percentage trunk fat
- Blood pressure
- Resting energy expenditure
- Fasting glucose
- Urine norepinephrine
- TSH level
- FT_3 and FT_4 levels
- Lipid profile
- Psychological and behavioral measures

Independent Variables

- Dietary sucrose intake

Control Variables

- Deviations from study diet
- Hunger level

Description of Actual Data Sample:

Initial N: 52 females

Attrition (final N): 42 females, 20 in the high sucrose group, 22 in the low sucrose group

Age: High sucrose group: 40.6 ± 8.2 years, low sucrose group: 40.3 ± 7.3 years

Ethnicity: 24 whites, 18 blacks

Other relevant demographics: None

Anthropometrics:

- No significant differences between groups in baseline BMI, percentage total body fat or percentage trunk fat

Location: Durham, North Carolina

Summary of Results:

Key Findings

- Weight, REE, percentage total body fat and percentage trunk body fat
  - No significant difference between groups in mean weight, REE, percentage total body fat or percentage trunk fat
  - Time effect was significant for weight ($p<0.001$, $n^2=0.88$), percentage total body fat ($p<0.001$, $n^2=0.51$), percentage trunk fat ($p<0.001$, $n^2=0.50$), REE ($p<0.001$, $n^2=0.54$), diastolic blood pressure ($p>0.001$, $n^2=0.10$) and systolic blood pressure ($p>0.001$, $n^2=0.10$); all scores decreased over the study duration
  - All group-by-time interactions for weight, percentage total body fat, percentage trunk fat, REE, diastolic blood pressure and systolic blood pressure were non-significant; indicating that groups did not differ in the magnitude of this decrease over the duration of the study
- Fasting glucose, TSH, FT_3 and FT_4
  - No significant group differences were found for fasting glucose, urine norepinephrine, TSH, FT_3 or FT_4
  - Significant time effect for norepinephrine ($p<0.001$, $n^2=0.15$) and FT_3 ($p<0.001$, $n^2=0.13$) with concentrations decreasing over time
  - Small but significant increase in FT_4 over time ($p=0.001$, $n^2=0.13$)
  - No significant group-by-time interactions were detected
- Plasma lipids
  - Mean concentrations of fasting total cholesterol, LDL cholesterol, HDL cholesterol and triacylglycerol were not significantly different between groups
  - Time effect significant for all lipid measures: total cholesterol ($p<0.001$, $n^2=0.63$), HDL cholesterol ($p<0.001$, $n^2=0.73$), LDL cholesterol ($p<0.001$, $n^2=0.32$) and triacylglycerol ($p=0.04$, $n^2=0.10$)
  - Time-by- group effect was significant for total cholesterol ($p=0.009$) and LDL cholesterol ($p=0.014$) with the low-sucrose group exhibiting a larger decrease than the high-sucrose group for both measures
- Psychologic and behavioral variables
  - No significant group differences in mean levels of hunger, negative affect, positive affect, depression, anxiety, or in the vigilance task
  - Time effect significant for negative affect ($p<0.001$, $n^2=0.47$), depression ($p<0.001$,$n^2=0.29$), positive affect ($p<0.001$, $n^2=0.43$) and the vigilance task ($p=0.005$, $n^2=0.13$) with all subjects improving on these measures

	Baseline High Sucrose	Baseline Low Sucrose	Posttreatment High Sucrose	Posttreatment Low Sucrose	Interaction Term (P)	Interaction Effect Size (n^2)
Weight (kg)	96.69±12.62	96.1±13.68	89.74±12.51	88.73±13.2	0.64	0.02
REE (kJ/day)	6901.09±1104.24	6795.03±1129.01	5973.92±787.18	5998.27±720.82	0.62	<0.01
Percentage total body fat	49.71±3.52	48.67±3.01	48.54±3.68	47.07±3.81	0.38	0.02
Percentage trunk fat	48.84±4.94	47.51±5.4	45.93±5.84	45.26±6.44	0.66	<0.01
Systolic blood pressure (mmHg)	139.5±16.02	131.82±13.52	127.95±14.59	129.67±11.28	0.99	<0.04
Diastolic blood pressure (mmHg)	74.85±11.08	72.82±9.02	71.5±11.95	69.1±8.29	0.14	<0.01
Total cholesterol (mmol/L)	4.63±0.77	4.92±0.84	4.14±0.75	3.94±0.62	0.009	0.16
LDL (mmol/L)	2.7±0.5	3.04±0.74	2.6±0.62	2.38±0.55	0.01	0.15

HDL (mmol/L)	1.35±0.34	1.29±0.22	1.06±0.19	1.03±0.19	0.68	<0.01
Total triacylglycerol (mmol/L)	1.19±0.94	1.29±0.71	1.08±0.59	1.05±0.45	0.6	<0.01

Other Findings

- Time effect significant for hunger ($p=0.008$, $n^2=0.08$) with all subjects reporting lower levels of hunger at the end of the study than at the beginning

Author Conclusion:

A high take of sucrose from a low-fat, hypoenergetic diet did not adversely affect weight loss or other metabolic indexes when compared with an isoenergetic diet in which sucrose was replaced by starches and aspartame. Both diet groups showed equal significant reductions in weight, percentage body fat, REE, urinary norepinephrine and FT_3 as well as an equal increase in FT_4, suggesting that the metabolic effects of these diets were similar. No behavior sequelae accompanying high intakes of sucrose. The study failed to find any adverse metabolic or behavioral effects of high sucrose consumption in a low-fat, weight-loss diet.

Reviewer Comments:

- *Greater drop-out rates among the high sucrose diet group*
- *Dietary program only 6 weeks long*
- *Diet compliance was measured by daily diary entries but not discussed*
- *Efforts were made to duplicate food appearance for both diets*
- *Both groups ate in same dining room therefore not blinded to the intervention*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes

2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	No
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A

6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	???
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	Yes
6.6.	Were extra or unplanned treatments described?	Yes
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	No
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	Yes
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes

	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		???
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	???